Supporting a switch between channels for a multicast transmission

FIELD OF THE INVENTION

The invention relates to methods supporting a switch between a point-to-multipoint channel and a point-to-point channel for transmitting multicast data from a mobile communication network to a mobile station. The invention relates equally to a corresponding mobile station, to corresponding sub-networks of a mobile communication network, to corresponding mobile communication systems and to corresponding software program products.

BACKGROUND OF THE INVENTION

A mobile communication network can transmit data to a mobile station over the radio interface using a point-to-point (p-t-p) transmission or a point-to-multipoint (p-t-m) transmission.

A p-t-p transmission is a single transmission that is addressed to a unique mobile station and that can be received only by this unique mobile station. Figure 1 illustrates in an upper part such a point-to-point transmission from a network NW to a mobile station MS. A p-t-m transmission, in contrast, is a single transmission that is addressed to a plurality of mobile stations and that can be received by this plurality of mobile stations. Figure 1 illustrates in a lower part such a point-to-multipoint transmission from a network NW to a plurality of mobile stations MS. In the following, a p-t-p channel refers to a radio channel on which a p-t-p transmission is carried out, and a p-t-m channel refers to a radio channel on which p-t-m transmission is carried out. Similarly, a p-

t-p bearer refers to a radio bearer which is used on a p-t-p channel, and a p-t-m bearer refers to a radio bearer which is used on a p-t-m channel.

For Multimedia Broadcast and Multicast Services (MBMS), for example, it is planned to allow MBMS data transmissions via p-t-p channels and/or p-t-m channels. It is further planned, that a switch between a point-to-point channel and a point-to-multipoint channel is enabled during an ongoing data transfer.

Figure 2a is a table presenting an exhaustive list of the bearer changes that are expected to occur for MBMS services within a cell, and figure 2b is a table presenting an exhaustive list of the bearer changes that are expected to occur for MBMS services after cell change. Both tables were taken from the document 3GPP TSG GERAN2#14bis, G2-030374, "MBMS bearer changes", Nokia, San Diego, CA, USA, 19-23 May, 2003. P-t-p to p-t-p and p-t-m to p-t-m changes are required within a cell and after a cell change due to possibly required reconfigurations of the physical resources. Within a cell, p-t-p to p-t-m changes are carried out only if *n* p-t-p bearers consume significantly more radio resources than one p-t-m. The default assumption is the usage of p-t-m anyhow. P-t-m to p-t-p changes are carried out only if a non-MBMS service is established in parallel to the MBMS service. After a cell change, p-t-p to p-t-m changes are carried out only if p-t-m is already established in the new cell. P-t-m to p-t-p changes are carried out only if p-t-m is not already established in the new cell. This requires the mobile station to notify itself to the network.

It is an assumption in on-going discussions on MBMS that for allowing a switch between a p-t-p bearer and a p-t-m

bearer during an active multicast session, i.e. while data transfer is on-going, some synchronization is needed between the p-t-p bearer and the p-t-m bearer so that the application in the mobile station can continue running normally after the bearer change. A prerequisite for this is the tolerance of the application to the data interruption, which may be lossless or lossy, caused by the bearer change. While a lossless data interruption causes basically no problem in case of background traffic apart from taking more time to receive the payload, it could affect the user perception in case of streaming traffic when the interruption lasts longer than the duration corresponding to the amount of data in the application buffer. The user may experience, for example, a black screen, a freeze in a video presentation or silence in an audio presentation. It has to be noted, however, that it is acknowledged that bearer changes should be avoided during an active session.

While the necessity of supporting a switch from a p-t-p channel to a p-t-m channel is not clear yet, the reverse switch from a p-t-m channel to a p-t-p channel has to be supported. It is assumed that for a parallel support of MBMS and non-MBMS services, the MBMS service should be provided to the mobile station via a p-t-p connection. Thus, the establishment of a non-MBMS service for a particular mobile station monitoring one or more given MBMS service on the p-t-m channel may lead, depending on the capabilities of the mobile station, to the establishment of an MBMS p-t-p connection once the non-MBMS service is established, in order to ensure MBMS service continuity.

A p-t-p link can be optimized individually for each mobile station by means of link adaptation and power control. It is a characteristic of a p-t-m channel, on the contrary,

that the link is not optimized individually for each mobile station. For example, no link adaptation occurs, and the signal power has to be sufficient to address all mobile stations monitoring the channel.

The resulting discrepancy in service between p-t-p transmissions and p-t-m transmissions is illustrated in figures 3a and 3b. Figure 3a is a diagram showing an area A in which a mobile station may acquire p-t-p and p-t-m channels in case of a good coverage and/or a high link quality. Figure 3b is a diagram showing a first area A corresponding to the area A of figure 3a. Due to the enabled link adaptation and power control, a mobile station may acquire p-t-p channels throughout this area A even in case of a weak coverage and/or a bad link quality. Figure 3b further shows a second area B, which is considerably smaller than the first area A and which lies within the first area A. In case of a weak coverage and a bad link quality, a mobile station is only able to acquire p-t-m channels in this reduced area B.

This raises a problem which has not been dealt with so far. P-t-m data may be lost, when the radio link quality drops below the minimum quality required at the mobile station for acquiring the p-t-m channel. In case a mobile station is acquiring data for a given service over p-t-m and the radio conditions weakens, the mobile station may not be able to get the data through anymore.

SUMMARY OF THE INVENTION

It is an object of the invention to ensure a continuous reception of data for a multicast service at a mobile station.

It is further an object of the invention to support a reduction of the amount of radio resources occupied by a multicast service.

For a first aspect of the invention, a method supporting a switch from a p-t-m channel to a p-t-p channel for transmitting multicast data from a mobile communication network to a mobile station is proposed. In a first step of this method, the mobile station determines a link quality of a p-t-m channel based on link quality related measurements on the p-t-m channel, which p-t-m channel is currently used by the mobile communication network for transmitting multicast data. In a second step of this method, the mobile station requests from the mobile communication network the transmission of the multicast data via a p-t-p channel, in case the determined link quality lies below a given link quality.

For the first aspect of the invention, moreover a mobile station is proposed, which comprises a measuring portion for performing link quality related measurements on a p-t-m channel via which the mobile station receives multicast data from a mobile communication network. The mobile station further comprises a processing portion for determining a link quality of a p-t-m channel based on measurement results provided by the measuring portion and for comparing a determined link quality with a given link quality. The mobile station further comprises a transmitting portion for transmitting a request to a mobile communication network to transmit multicast data via a p-t-p channel, in case the processing portion detects that a determined link quality of a p-t-m channel employed for transmitting the multicast data lies below a given link quality.

For the first aspect of the invention, moreover a sub-network of a mobile communication network is proposed, which comprises a receiving portion for receiving from a mobile station a request to switch from using a p-t-m channel to using a p-t-p channel for transmitting multicast data to the mobile station. The sub-network further comprises a processing portion for switching upon such a request received by the receiving portion from using a p-t-m channel to using a p-t-p channel for transmitting multicast data to the mobile station.

For the first aspect of the invention, moreover a mobile communication system is proposed which comprises the mobile station and the sub-network proposed for the first aspect of the invention.

For the first aspect of the invention, finally a software program product is proposed, in which a software code for supporting a switch from a point-to-multipoint channel to a point-to-point channel for transmitting multicast data from a mobile communication network to a mobile station is stored. When running in a processing component of a mobile station, e.g. in the processing portion of the above proposed mobile station, the proposed software code realizes a step of determining a link quality of a point-to-multipoint channel based on link quality related measurements on the point-to-multipoint channel, which point-to-multipoint channel is currently used by the mobile communication network for transmitting multicast data. The proposed software code further realizes a step of causing a request to the mobile communication network to transmit the multicast data via a point-to-point channel, in case the determined link quality lies below a given link quality.

For a second aspect of the invention, a method supporting a switch from a p-t-p channel to a p-t-m channel for transmitting multicast data from a mobile communication network to a mobile station is proposed. In a first step of this method, the mobile communication network estimates a link quality of a p-t-m channel while transmitting multicast data on a point-to-point channel to the mobile station. In a second step of this method, the mobile communication network orders the mobile station to switch from the p-t-p channel to the p-t-m channel for receiving the multicast data, in case the estimated link quality of the p-t-m channel reaches a required link quality.

For the second aspect of the invention, moreover a sub-network of a mobile communication network is proposed, which comprises a transmitting portion for transmitting multicast data using at least one of a p-t-p channel and a p-t-m channel. The sub-network further comprises a processing portion for estimating the link quality of a p-t-m channel while the transmitting portion uses a p-t-p channel for transmitting multicast data to a mobile station, and for ordering this mobile station to switch from the p-t-p channel to the p-t-m channel for receiving the multicast data, in case the estimated link quality lies above a required link quality.

For the second aspect of the invention, moreover a mobile communication system is proposed which comprises the sub-network proposed for the second aspect of the invention and in addition a mobile station including a receiving portion for receiving multicast data from a mobile communication network.

For the second aspect of the invention, finally a software program product is proposed, in which a software code for

supporting a switch from a point-to-point channel to a point-to-multipoint channel for transmitting multicast data from a mobile communication network to a mobile station is stored. When running in a processing component of a mobile communication network, e.g. in the processing portion of the above proposed sub-network, the proposed software code realizes a step of estimating a link quality of a point-to-multipoint channel while the mobile communication network is transmitting multicast data on a point-to-point channel to the mobile station.
The proposed software code further realizes a step of causing an order to the mobile station to switch from the point-to-point channel to the point-to-multipoint channel for receiving the multicast data, in case the estimated link quality of the point-to-multipoint channel reaches a required link quality.

The invention proceeds from the consideration that p-t-p allows a reaching of potentially higher QoS requirements than p-t-m in all channel conditions. Thus, there is a discrepancy in service provision between p-t-p and p-t-m transmissions, which has to be taken into account when enabling a switching between p-t-p and p-t-m channels. While a service which is being transmitted over a p-t-m channel could well be transferred to a p-t-p channel, it might not necessarily be possible to achieve the opposite. If the same service can be provided through either a p-t-p transmission or a p-t-m transmission within good coverage, it may not be possible to provide a given service over a p-t-m channel when the coverage and/or the link quality weakens, for example at cell borders.

For the first aspect of the invention, it is therefore proposed to switch from a p-t-m to a p-t-p transmission when the reception on a p-t-m channel becomes critical due

to a low radio link quality. This requires the mobile station to process link quality measurements on the p-t-m channel and to be aware of the minimum acceptable link quality level for p-t-m reception for a given service or for the p-t-m channel as a whole.

It is an advantage of the first aspect of the invention that it allows the ensuring of a multicast service continuity when the radio conditions become too bad to continue the acquisition of a given service on a p-t-m channel.

For the second aspect of the invention, it is proposed to switch from a p-t-p to a p-t-m transmission when the radio conditions become good enough for acquisition of a given multicast service on a p-t-m channel. The sub-network is enabled to this end to estimate the channel quality of the p-t-m channel. The mobile communication network may estimate the link quality for example based on measurement reports from a mobile station comprising results of measurements performed by the mobile station for the p-t-p channel. It has to be noted, however, that the mobile communication network may have other means to estimate the link quality as well. If the link quality is sufficiently high, the mobile communication network may then order the mobile station to switch from the p-t-p channel to this p-t-m channel for receiving the multicast data. If the mobile communication network is not transmitting the same multicast data on a p-t-m channel anyhow, it further switches from using the p-t-p channel to using the p-t-m channel for transmitting the multicast data.

It is an advantage of the second aspect of the invention that it allows a sparing of radio resources, since a p-t-m channel can be used for transmitting the same multicast

data via a single channel to several mobile stations. At the same time, it is ensured that a switching is only performed in case the p-t-m channel is suited for a transmission to a particular mobile station.

In case a p-t-p link quality is used to estimate the channel quality of a p-t-m link, it is a prerequisite that the channel quality of the p-t-p link is a fairly good representative of the channel quality of the p-t-m link. The impacts of the mobility of the mobile station are assumed to be similar across all timeslots allocated to this mobile station. That is, the fading type, e.g. slow or fast fading, experienced by a mobile station is the same across all timeslots, only the amplitude of the fading changes. In fact, in case of multislot allocation, all timeslots in the allocation are subject to the same frequency parameters, hence, if frequency hopping is used, the same hopping sequence is usually applied to all timeslots, as described in the technical specification 3GPP TS 44.060 V.5.1.1: "Technical Specification Group GSM/EDGE Radio Access Network; General Packet Radio Service (GPRS); Mobile Station (MS) - Base Station System (BSS) interface; Radio Link Control/Medium Access Control (RLC/MAC) protocol" (2002-05) and in the technical specification 3GPP TS 45.002 V.6.2.0: "Technical Specification Group GSM/EDGE Radio Access Network; Multiplexing and multiple access on the radio path" (2003-06).

The hopping characteristics of the p-t-p channel and the p-t-m channel may be one of the following cases:

a) p-t-p is hopping and p-t-m is not hopping;
b) p-t-p is hopping and p-t-m is hopping;
c) p-t-p and p-t-m are hopping with different hopping sequences, i.e. the list of frequencies in the sequences

are different between the p-t-p channel and the p-t-m channel;

d) neither p-t-p nor p-t-m are hopping; and

e) p-t-p and p-t-m are hopping with the same or with a different hopping sequence, but the list of frequencies in the sequence(s) is the same.

The highest synergies between p-t-p and p-t-m link qualities are reached in the above cases d) and e), and possibly in case c). Besides, the likelihood for encountering case a) or case b) in a real network is assumed to be low if not null, unless for case a) PBCCH (Packet Broadcast Control CHannel) and PCCCH (Packet Common Control CHannel) are not supported in the cell since the BCCH (BroadCast CHannel) carrier cannot hop and the p-t-m is located the BCCH carrier, which is unlikely when MBMS is deployed.

Both aspects have in common that the mobile communication network is caused to switch between a p-t-m channel and a p-t-p channel for transmitting multicast data to the mobile station, in case the determined or estimated link quality on the p-t-m channel indicates that a switch is recommendable.

It is to be understood that both aspects of the invention can advantageously be combined in a single mobile station, a single sub-network and a single mobile communication system, respectively. In this case, however, care should be taken to avoid a ping-pong effect due to a repeated switching between a p-t-m channel and a p-t-p channel.

The invention can be employed in particular for MBMS services, but equally for any other kind of multicast services.

The invention can further be used for example, though not exclusively, with GERAN (GSM/EDGE Radio Access Network) or UTRAN (UMTS Terrestrial Radio Access Network). The sub-network may thus be for example a GERAN or an UTRAN, a BSS (Base Station Subsystem) of a GERAN or an RNS (Radio Network Subsystem) of an UTRAN, or one or more network elements of such a BSS or such an RNS.

Other objects and features of the present invention will become apparent from the following detailed description considered in conjunction with the accompanying drawings. It is to be understood, however, that the drawings are designed solely for purposes of illustration and not as a definition of the limits of the invention, for which reference should be made to the appended claims. It should be further understood that the drawings are not drawn to scale and that they are merely intended to conceptually illustrate the structures and procedures described herein.

BRIEF DESCRIPTION OF THE FIGURES

Fig. 1 is a diagram illustrating p-t-p and p-t-m transmissions;

Fig. 2a and b are tables indicating planned bearer changes in a cell and after a cell change, respectively;

Fig. 3a and b are diagrams illustrating the coverage with p-t-m and p-t-p channels in case of good and bad conditions, respectively;

Fig. 4 is a schematic block diagram illustrating a radio access network and a mobile station as part of a mobile communication system in which an embodiment of the invention is implemented;

Fig. 5 is a rough signaling diagram illustrating an embodiment of the method according to the invention;

Fig. 6 is a table showing different link quality levels for different MBMS services; and

Fig. 7 is a further rough signaling diagram illustrating an embodiment of the method according to the invention.

DETAILED DESCRIPTION OF THE INVENTION

Figure 4 is a schematic block diagram of a part of a mobile communication system in which a BSS 410 of a mobile communication network may switch between p-t-m and p-t-p transmissions to a specific mobile station 420 in accordance with the invention.

The BSS 410 can be for instance a sub-network of a GERAN. It comprises a transceiver 411, a channel selection and control portion 412, a p-t-m to p-t-p processing portion 413 and a p-t-p to p-t-m processing portion 414. The channel selection and control portion 412 has a data input for receiving MBMS data and an output which is connected to the transceiver 411. The p-t-m to p-t-p processing portion 413 has an input which is connected to the transceiver 411 and an output which is connected to a first control input of the channel selection and control portion 412. The p-t-p to p-t-m processing portion 414 has equally an input which is connected to the transceiver 411 and an output which is connected to a second control input of the channel selection and control portion 412. The depicted components of the BSS 410 may belong to a single network element or be distributed to several network elements. It is further to be understood that the BSS 410 comprises additional components as known from the art, which are not depicted in

figure 4. The depicted connections may be direct connections or indirect connections via other components not shown.

The mobile station 420 comprises a transceiver TX/RX 421, a measuring portion 422, a p-t-m to p-t-p processing portion 423 and a p-t-p to p-t-m processing portion 424. The transceiver 421 is connected to an input of the measuring portion 422, to an input of the p-t-m to p-t-p processing portion 423 and to an input of the p-t-p to p-t-m processing portion 424. An output of the measuring portion 422 is connected on the one hand to an input of the p-t-m to p-t-p processing portion 423 and on the other hand to a second input of the p-t-p to p-t-m processing portion 424. An output of the p-t-m to p-t-p processing portion 423 and an output of the p-t-p to p-t-m processing portion 424 are connected to the transceiver 421. It is to be understood that also the mobile station 420 comprises additional components as known from the art, which are not depicted in figure 4. The depicted connections may be direct connections or indirect connections via other components not shown.

The BSS 410 and the mobile station 420 of figure 4 are designed for supporting both, a switch from a p-t-m transmission to a p-t-p transmission of MBMS data and a switch from a p-t-p transmission to a p-t-m transmission of MBMS data.

The network does not offer any guarantee of reception of the data sent over the p-t-m channel. Therefore, a switch from a p-t-m transmission to a p-t-p transmission is enabled for the case that the mobile station 420 receives MBMS data via a p-t-m channel but can no longer acquire MBMS data through this p-t-m channel due to a drop of the

link quality in this channel. This is the case, for example, when the mobile station 420 is located within area A of the above described figure 3b, but outside of area B of this figure. A channel switching in such a situation will be explained in the following with reference to figure 5.

Figure 5 is a signaling diagram illustrating the transmissions between the BSS 410 and the mobile station MS 420, and in addition some of the processing at the mobile station MS 420.

When MBMS data is received at the BSS 410, the channel selection and control portion 412 first selects a p-t-m channel for transmission of the MBMS data to all mobile stations which are to receive the MBMS data. The channel selection and control portion 412 establishes a p-t-m bearer on this channel and transmits bearer parameters required for a given service via the transceiver 411 to the mobile stations. Together with the bearer parameters, the channel selection and control portion 412 transmits a maximum value for the mean bit error probability MEAN_BEPmax and a minimum coefficient of variation of the bit error probability CV_BEPmin as threshold values to the mobile stations. The MBMS data is then transmitted via the transceiver 411 of the BSS 410 to the mobile stations using a single channel on the established p-t-m bearer. A new maximum value for the mean bit error probability MEAN_BEPmax and a new value for the minimum coefficient of variation of the bit error probability CV_BEPmin is transmitted to the mobile stations whenever a reconfiguration of the p-t-m bearer becomes necessary. All p-t-m related transmissions are indicated in figure 5 as step 51.

Before the start of the MBMS data transmission, the mobile station 420 receives the threshold values MEAN_BEPmax and CV_BEPmin via its transceiver 421 and provides them to the p-t-m to p-t-p processing portion 423. The mobile station 420 then receives the MBMS data via its transceiver 421 and forwards the data to the measuring portion 422. The measuring portion 422 performs link quality measurements on all p-t-m channels from which the mobile station 420 receives MBMS data. This is indicated in figure 5 as step 52. More specifically, the measuring portion 422 performs BEP (Bit Error Probability) measurements as introduced for EGPRS in the technical specification 3GPP TS 45.008 V5.11.0: "Technical Specification Group GSM/EDGE Radio Access Network; Radio subsystem link control", (2003-06), which is incorporated by reference herein. In this document it is requested, for instance, that the received signal quality for a channel is measured on a burst-by-burst basis in a manner that can be related to the BEP (Bit Error Probability) for each burst before channel decoding using, for example, soft output from the receiver. The measuring portion 422 forwards measured BEP related values to the p-t-m to p-t-p processing portion 423.

Based on the received measurement results, the p-t-m to p-t-p processing portion 423 calculates a MEAN_BEP (mean bit error probability) value and a CV_BEP (Coefficient of Variation of the BEP) value and compares the calculated values with the threshold values received from the BSS 410. This is indicated in figure 5 as step 53. As long as the calculated MEAN_BEP value remains below the received value MEAN_BEPmax and the calculated CV_BEP value remains above the received value CV_BEPmin, the mobile station 420 continues with the acquisition of the MBMS data through the p-t-m channel. This is indicated in figure 5 as step 54. A calculation of the values MEAN_BEP and CV_BEP is presented

for example in the above mentioned technical specification TS 45.008.

In case the calculated MEAN_BEP value raises above the received value MEAN_BEPmax or in case the calculated CV_BEP value falls below the received value CV_BEPmin, however, it is assumed that the mobile station 420 might no longer be able to acquire the data on the p-t-m channel correctly. Therefore, the p-t-m to p-t-p processing portion 423 transmits a p-t-p request via the transceiver 421 to the BSS 410. This is indicated in figure 5 as step 55.

The p-t-m to p-t-p processing portion 413 of the BSS 410 receives this request via transceiver 411 and provides a corresponding control information to the channel selection and control portion 412. The channel selection and control portion 412 transmits thereupon via the transceiver 411 a p-t-p assignment to the mobile station 420, in order to establish a p-t-p bearer. This is indicated in figure 5 as step 56. Thereafter, the channel selection and control portion 412 transmits the MBMS data via the transceiver 411 to the mobile station 420 using the established dedicated p-t-p channel. This is indicated in figure 5 as step 57. The p-t-p connection can be controlled by means of a link adaptation and a power control, as known from the art, in order to guarantee the required link quality.

It is to be noted that the mobile station 420 may receive more than one MBMS service on the p-t-m channel in parallel. Different received services may have different minimum link quality levels. For example, higher bitrates typically require a higher link quality. Therefore, the trigger for a p-t-p request by the mobile station 420 has to be based on the tightest link quality requirement. For illustration, the table of figure 6 presents a list of MBMS

services monitored by the mobile station, *Service i*, with i=1 to n. To each of the services, a dedicated minimum link quality level LQL_i is assigned, with i=1 to n. The list is sorted by the link quality levels according to the relation $LQL_i \geq LQL_{i+1}$, with i=1 to n-1. That is, *Service 1* requires the highest minimum link quality level LQL_1, and *Service n* requires the lowest minimum link quality level LQL_n. Therefore, the p-t-m to p-t-p processing portion 423 calculates and monitors only the MEAN_BEP and the CV_BEP of *Service 1*.

A switch from a p-t-p to a p-t-m bearer is enabled in the system of figure 4 in order to save radio resources, if possible, in the case that the mobile station 420 receives MBMS data via a p-t-p channel. Such a situation will be explained in the following with reference to figure 7.

Figure 7 is a signaling diagram illustrating the transmissions between the BSS 410 and the mobile station 420, and in addition some processing in the BSS 410 and at the mobile station 420.

First, the channel selection and control portion 412 of the BSS 410 forwards MBMS data to the mobile station 420 using a dedicated p-t-p channel. This is indicated in figure 7 as step 71. The transmission may comprise a link quality measurement request, e.g. at regular intervals.

The mobile station 420 receives the bitstream comprising the MBMS data via its transceiver 421 and forwards the received bits to the measuring portion 422. The measuring portion 422 measures the link quality of all p-t-p channels from which the mobile station 420 receives MBMS data. The measuring portion 422 may perform for example again BEP measurements as introduced in the above mentioned technical

specification 3GPP TS 45.008. This is indicated in figure 7 as step 72. The measuring portion 422 forwards the measurement results to the p-t-p to p-t-m processing portion 424.

In case the transmission in step 71 includes a measurement request, this request is provided by the transceiver 421 to the p-t-p to p-t-m processing portion 424.

The p-t-p to p-t-m processing portion 424 monitors whether a measurement request is received from the BSS 410. This is indicated in figure 7 as step 73. As long as no measurement request is received, the link quality measurements are continued. This is indicated in figure 7 as step 74.

In case a measurement request is received, the p-t-p to p-t-m processing portion 424 transmits a measurement report via the transceiver 421 to the BSS 410. This is indicated in figure 7 as step 75. The measurement report comprises the results of the measurements provided by the measuring portion 422 to the p-t-p to p-t-m processing portion 424.

In the BSS 410, the measurement report is forwarded by the transceiver 411 to the p-t-p to p-t-m processing portion 414. The p-t-p to p-t-m processing portion 414 estimates the currently achievable p-t-m channel quality, for instance by extrapolating the measured link quality on the p-t-p channel received in the measurement report. This is indicated in figure 7 as step 76.

In case the estimated achievable p-t-m channel quality lies below a given threshold value, the transmission via the p-t-p channel is continued. This is indicated in figure 7 as step 77. The threshold value may depend on the type of the MBMS service, as described with reference to figure 5.

In case the estimated achievable p-t-m channel quality lies above a given threshold value, it is assumed that the mobile station 420 can receive the MBMS data correctly through a p-t-m channel as well. Therefore, the p-t-p to p-t-m processing portion 414 causes the channel selection and control portion 412 to transmit a "Switch to p-t-m" order via the transceiver 411 to the mobile station 420. This is indicated in figure 7 as step 78. The "Switch to p-t-m" order comprises two messages. The first message is for instance a PACKET TBF RELEASE message and releases the p-t-p connection. The second message provides the p-t-m parameters required at the mobile station 420 for receiving data on a p-t-m channel. Alternatively, a single message could be used for releasing the p-t-p connection and for providing the p-t-m parameters. In either case, the p-t-m channel parameters for this particular service are advantageously informed to the mobile station 420 directly so that the mobile station 420 does not have to acquire these parameters through PBCCH or PNCH, respectively. This reduces the service gap during a bearer change.

Once the "Switch to p-t-m" order has been transmitted, the selection portion 412 forwards the MBMS data on a p-t-m channel via the transceiver 411 to the mobile station 420. This is indicated in figure 7 as step 79.

The mobile station 420 continues receiving the MBMS data on the p-t-m channel with a sufficient quality.

Special care has to be taken in case the mobile station 420 is not able to acquire a p-t-m channel in parallel with a p-t-p channel. In this case, all the p-t-p connections of the mobile station 420 have to be dropped, when a "Switch-to-p-t-m" order is sent to the mobile station 420.

Therefore, if the mobile station 420 is acquiring several MBMS services through several p-t-p connections, the "Switch to p-t-m" order by the BSS 410 should only be sent in case the highest required link quality of all the services which are monitored by the mobile station 420 is reached. In the table of figure 6, this corresponds to level LQL_1 for *Service 1*.

The coexistence of the two aspects depicted in figures 5 and 7 in the system of figure 4 leads to the risk of a ping-pong effect in the switching from p-t-p to p-t-m and vice versa, which should be avoided. Therefore, once the p-t-p connection is established, it may be kept for as long as the MBMS session is active. That is, a switching from a p-t-p transmission to a p-t-m transmission is avoided within a cell. Further, the network may be allowed, as usual, to reject a p-t-p request from the mobile station. Alternatively, the mobile station may be prevented from transmitting the p-t-p request. The latter alternative would reduce the signaling amount, since it avoids repeated request/reject signaling.

While there have shown and described and pointed out fundamental novel features of the invention as applied to a preferred embodiment thereof, it will be understood that various omissions and substitutions and changes in the form and details of the devices and methods described may be made by those skilled in the art without departing from the spirit of the invention. For example, it is expressly intended that all combinations of those elements and/or method steps which perform substantially the same function in substantially the same way to achieve the same results are within the scope of the invention. Moreover, it should be recognized that structures and/or elements and/or method steps shown and/or described in connection with any

disclosed form or embodiment of the invention may be incorporated in any other disclosed or described or suggested form or embodiment as a general matter of design choice. It is the intention, therefore, to be limited only as indicated by the scope of the claims appended hereto.